# Simple Machines: Doing Work on the Farm

Teacher Packet

FREDERIK MEIJER GARDENS & SCULPTURE PARK

Levers

Pulley

Wheel & Axle

Wheel & Axle and Wedge

**Overview:**
The student will learn vocabulary terms for simple machines as well as names of simple farm tools that represent each category of simple machine. He/she will learn how natural forces impact work done by simple machines.

Lessons and activities will be led by certified teachers and are taught outdoors in our beautiful farm setting. Please prepare all students and chaperones to "dress for weather". Teachers and chaperones will be asked to assist with activities.

**Activities:** The simple machines farm experience is two hours of activities in the following areas.

Make and use a simple wheelbarrow. (wheel & axle)
Move a weight up a ramp. (inclined plane)
Use a chisel and hammer on wood. (wedge)
Insert both a screw and nail into wood. (wedge / screw)
Compare three systems of pulleys. (pulleys)
Examine an old clock to see the gears at work. (wheel & axle)
Move a rock using a lever and fulcrum. (lever)
Pull a nail out of a piece of wood using a claw hammer. (lever)

The farm garden is ADA compliant.

## Main Concepts:

**Work** - Scientists measure "work" as something done only when a force moves an object.

**Machine** - A machine is a device that makes work easier. Machines do not increase the amount of work done, but they save time doing work.

**Simple Machines** –

| | |
|---|---|
| There are three simple machines: | lever<br>pulley<br>inclined plane. |
| Modifications of these simple machines: | wheel & axle<br>wedge<br>screw |

Simple machines form the basis for all other mechanical devices.

A compound machine is made of two or more simple machines.

## Vocabulary:

These terms are offered to refresh understanding for the teacher. Each is mentioned in required benchmarks.

**effort:** a force that is applied to a body or object and directs the motion in a simple machine

**friction:** a force that acts against motion when two surfaces are touching. Friction slows down or stops an object in motion. Friction can be a positive as well as negative force.

**gravity:** The force of one object pulling against another. Think of earth's gravity pulling down on things. The bulk, weight or mass of an item demonstrates gravity and the force between the objects.

**force:** Force means anything that pushes or pulls to change the motion of an object.

**distance:** a measurement of the space that an object moves.

**inclined plane:** a plank or other plane surface set at an acute angle to a horizontal surface. This is used to move an object to a lower or higher place.

**screw:** An inclined plane wrapped around itself, a screw forms ridges. Used to raise or lower things or to fasten objects together.

**lever:** a bar which turns on a fixed support (fulcrum) used to transmit effort and motion

**pulley:** a wheel with a grooved rim in which a rope or cable can more easily pull and lift a load

**wedges:** Two inclined planes back to back form a sharp edge. Used to split things apart.

**wheel & axle:** The axle is a rod on which a wheel(s) is fastened. This lets the wheel rotate. It is used to move things from place to place.

**gears:** Wheels with teeth, gears can be used to gain force or speed.

## Curriculum standards and benchmarks:

### State of Michigan Strand – Physical Science:

Concept of Standard:
Motion of objects is accounted for by gravitational, electromagnetic and nuclear forces.

PMO.IV.3

4. Identify and use simple machines and describe how they change effort.
Key concepts: Inclined planes, levers, pulley, wedges, wheel and axle, force, distance,

5. manipulate simple mechanical devices and explain how their parts work together.
Key concepts: names and uses for parts of machines. Such as levers, wheel and axle, pulleys, inclined planes, gears, screws, wedges.

Vocabulary: effort, friction, gravity, force, distance, inclined planes, screw, levers, pulley, wedges, wheel and axle, gears

# Classroom Activities:

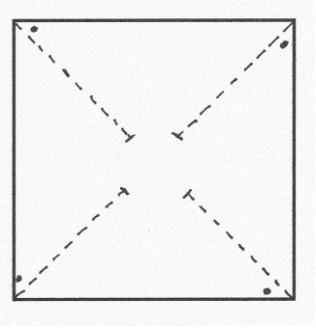
**Classroom treasure hunt:** begin a collection of simple tools on a table in the classroom. Include things like rulers, wedges, nails, nut & bolts, screws, small wheels, eggbeaters, a pencil sharpener, stapler, fork, scissors, tape cassette. . Invite students to bring in something from home to place on the table. Allow students to handle materials. Make six columns on the board and label each: lever, wedge, wheel & axle, inclined plane, pulley and screw. Have students name similar attributes of the objects and put them into each group. Hint - some may appear in more that one column. Put this chart on paper and then add to it after your visit to FMG&SP.

**Gravity experiment:** Materials: jars, index cards, quarters. Students may work in small groups for this activity. Put a jar on each table with an index card across its top. Center a quarter above the mouth of the jar. Quickly move the index card. What happens to the quarter? What force pulled the quarter into the jar?

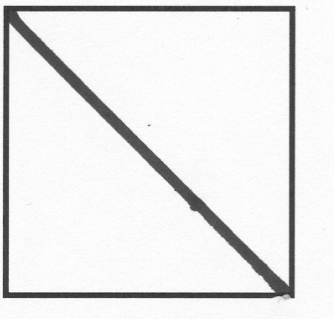
**Friction experiment:** Materials: fine and course sandpaper, waxed surface, carpet, square of rubber, pencils, small box of weights, a heavy rubber band, and ruler. Students may work in small groups for this activity. Staple the rubber band to the front center of the box. Predict the measure of force (distance the rubber band stretches) as the load is pulled over each surface. How does friction change the work done? Chart the results.
Discuss friction in our daily lives. When is it useful? Examples: good traction on basketball shoes, sand on icy sidewalk, good treads on car tires, etc. When is friction a hindrance? Examples: moving furniture, sliding on a rough surface, moving parts of a machine rubbing and wearing out, etc

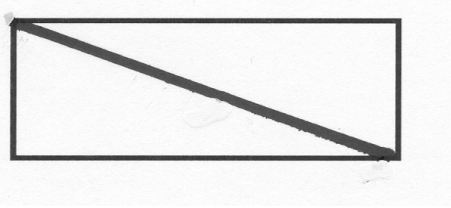
**Paper and tools:** Materials: squares of scrap paper, tools – (scissors, crayons, paper punch, and stapler).
"How many ways can the paper be changed without using tools?" (folded, crushed into a ball, torn). Hand out tools "What additional changes could we make using tools?" What happens when we drop the paper? What force is that?

**Pinwheel:** Materials: paper, ruler, pencil, scissors and straight pins.
Cut along the dotted lines of an 8 ½"sq. leaving a center area. Put a pin in the dot on the lower right hand corner of each triangle as shown. Hint -- the paper is gently curled not folded toward the center. The pinwheel is pinned loosely through the pencil eraser and can turn when blown upon. This is an example of a wheel and axle.



**Paper screws:** Materials: paper: 1 cut into a 5" square and a second into a 5" by 8" rectangle, rulers, crayons, pencils, and scissors.
Students can work in teams of two for this project. Draw a heavy diagonal and then cut right through the center of it. Starting at one of the sides (not the diagonal) begin rolling it around the pencil. What have you made? Count the number of coils around the pencil. Is the pitch of the screw steep? Repeat with the rectangular paper. How do the number of coils and the pitch vary depending on whether you rolled from the long or short side? How does it compare to the first screw created?





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